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RECORDS OF MEETINGS.

Nine hundred and sixty-seventh Meeting.

OCTOBER 10, 1906. — STATED MEETING.

The Academy met at its House.

The PRESIDENT in the chair.

There were present twenty-three Fellows.

The Corresponding Secretary read the following communications: From the University of Pennsylvania, inviting the Academy to send a representative to the dedication of the new building of its engineering department; from the Curator of the Reale Universita Napoli, offering for sale collections of specimens of the materials ejected in the recent eruption of Vesuvius; from the American Philosophical Society, presenting the medal struck by order of the Congress of the United States in honor of the two hundredth anniversary of the birth of Benjamin Franklin; one from the same Society acknowledging the address presented by the Academy on the occasion of the above celebration; from the Director of the Observatorio Astronomico de la Plata, announcing the annexation of the Observatorio to the Universidad Nacional; from the family of Ludwig Boltzmann, announcing his death, and also the same announcement from the University of Vienna; from the Museo Nacional, Mexico, announcing the death of Manuel Urbina, chief of the department of natural history.

The following deaths were announced by the Chair: —

Edward J. Young, Resident Fellow in Class III, Section 2; Bennett H. Nash, Resident Fellow in Class III, Section 2; Ludwig Boltzmann, Foreign Honorary Member in Class I, Section 2; J. W. A. Kirchhoff, Foreign Honorary Member in Class III, Section 2.

Professor G. F. Swain was appointed by the President to represent the Academy at the dedication of the building of the engineering department of the University of Pennsylvania.

At the request of the President, Professor Ware gave some information in regard to the ventilation of the Meeting-room, with its estimated cost. After some discussion, on motion of the Recording Secretary, the whole subject was referred to the President, with full power.

The following communications were given: —

"An Ascent of Orizaba, Mexico," by Professor John E. Wolff; "On Some Elements of Conservatism in Ancient Greece," by Professor Herbert Weir Smyth.

The following paper was presented by title: —

Contributions from the Gray Herbarium of Harvard University. New Series. — No. XXXIII. "Revision of the Genus Spilanthes." By Albert Hanford Moore. Presented by B. L. Robinson.

Nine hundred and sixty-eighth Meeting.

NOVEMBER 14, 1906.

The Academy met at its House.

The PRESIDENT in the chair.

There were present twenty-two Fellows.

The Corresponding Secretary read the following letters: From the Délégation pour l'Adoption d'une Langue Auxiliaire Internationale, offering to members of the Academy the resources of the Delegation for the propaganda in the United States; from the Board of Managers for Massachusetts, of the Jamestown Exposition, asking for the loan of objects of historical interest for display at the Exposition.

The following communications were given: —

"The Ancient Coniferous Flora of New England," by Professor E. C. Jeffrey; "The Ancient Water-levels of the Champlain and Hudson Valleys," by Professor J. B. Woodworth.

The following papers were read by title: —

"Description of Bermuda Hydroids." By Edgar Davidson Congdon. Presented by E. L. Mark.

"The Transmission of Röntgen Rays through Metallic Sheets." By John Mead Adams. Presented by John Trowbridge.

Nine hundred and sixty-ninth Meeting.

DECEMBER 12, 1906.

The Academy met at its House.

The PRESIDENT in the chair.

There were present twenty-two Fellows.

The Corresponding Secretary read a letter from Mr. Henry H. Edes, presenting to the Academy a photographic copy of the certificate of Membership in the Academy, which was given in 1781, to Benjamin Franklin.

On motion of the Corresponding Secretary, it was

Voted, That the thanks of the Academy be tendered to Mr. Edes for his gift.

The Chair announced the following deaths: —

Samuel Cabot, Resident Fellow in Class I, Section 3; F. Brunetière, Foreign Honorary Member in Class III, Section 4.

A proposition from the Council for the establishment of an emeritus list of Resident Fellows was read; this proposition, requiring a change in the statutes, was referred to a committee consisting of Charles P. Bowditch, A. Lawrence Rotch, William Watson.

The following recommendation from the Council was read by the Corresponding Secretary: —

That an appropriation of five hundred dollars ($500) be made from the income of the Publication Fund, for the use of the Publishing Committee for the remainder of the year.

The following communication was given: —

"The Surface Temperature of Mars (from a New Determination of the Solar Heat received by it)." By Professor Percival Lowell.

The following papers were read by title: —

"An Electric Wax-Cutter for Use in Reconstruction." By E. L. Mark.

"On the Magnetic Behavior of the Finely Divided Core of an Electro-magnet or of a Transformer while a Steady Current is being established in the Exciting Coil." By B. O. Peirce.

"The Sensation of Loudness." By W. C. Sabine.

Nine hundred and seventieth Meeting.

JANUARY 9, 1907. — STATED MEETING.

The Academy met at its House.

The PRESIDENT in the chair.

There were present twenty-five Fellows.

On the recommendation of the Council, at the request of the Chairman of the Publication Committee, and with the approval of the Treasurer, it was

Voted, To appropriate the sum of five hundred dollars ($500) from the income of the Publication Fund for the use of the Publication Committee for the remainder of the year.

On motion of the Chairman of the Rumford Committee, it was

Voted, To appropriate the sum of three hundred and seventy-five dollars ($375) from the income of the Rumford Fund for the use of the Rumford Committee in the furtherance of research.

The report of the Committee on Amendments to the Statutes was read and accepted, and, in accordance therewith, it was

Voted, To amend the Statutes as follows: —

Chapter I, Section 2, line 1. After the word "Fellows" add "residing in the Commonwealth of Massachusetts."

This amendment was passed by a vote of three-fourths of the members present, there being eighteen (18) affirmative votes.

The following communications were given: —

"The Meteorology of the North and South Polar Zones." By R. DeC. Ward.

"The Corpuscular Theory as applied to Electric Conduction in Gases." By Theodore Lyman.

The following papers were read by title: —

"On Linear Differential Equations of the Parabolic Type." By M. M. Smith. Presented by Maxime Bôcher.

"The Spermatogenesis of the Myriapods. V. On the Spermatocytes of Lithobius." By Maulsby W. Blackman. Presented by E. L. Mark.

"Concerning the Adiabatic Determination of the Heats of Combustion of Organic Compounds, especially Sugar and Benzol." By T. W. Richards, L. J. Henderson, and H. L. Frevert.

"Concerning Position Isomerism and Heats of Combustion." By L. J. Henderson. Presented by T. W. Richards.

"The Determination of Small Amounts of Antimony by the Berzelius-Marsh Process." By C. R. Sanger and James A. Gibson.

"The Determination of Arsenic in the Urine." By C. R. Sanger and Otis F. Black.

"The Determination of Arsenic by the Guthzeit Method." By C. R. Sanger and Otis F. Black.

Nine hundred and seventy-first Meeting.

FEBRUARY 13, 1907.

The Academy met at the Walker Building of the Massachusetts Institute of Technology.

The PRESIDENT in the chair.

There were present twenty-five Fellows and eighteen guests.

The following letters were read: From the Société Imperiale russe de Géographie, on the occasion of the eightieth anniversary of M. Pierre de Séménov; from E. van Everdingen, announcing his appointment as Director of the Netherlands Meteorological Institute; from the Académie de Macon, enclosing the medal of its centennial; from the Seventh International Zoölogical Congress, inviting the Academy to be represented by delegates at its meeting in Boston, August 19 to 23, 1907.

The President announced that the Rumford Medal had been awarded to Professor Ernest Fox Nichols for his researches on radiation, particularly on the pressure due to radiation, the heat of the stars, and the infra-red spectrum. He then called upon Professor Charles R. Cross, Chairman of the Rumford Committee, to state the grounds on which the award was made.

Professor Cross gave a brief account of Professor Nichols' researches, after which the President, in the name of the Academy, presented the medal to Professor Nichols, who made an appropriate reply expressing his appreciation of the high honor which had been conferred upon him.

Professor Nichols then showed experiments demonstrating the pressure of rays of light.

Remarks were made on this subject by Professor Webster, who concluded with the motion that a vote of thanks be given to Professor Nichols for his admirable experimental demonstrations.

The following papers were presented by title: —

"The Kathode-luminescence of Fluorite." By Harry W. Morse. Presented by John Trowbridge.

"On the Self and Mutual Inductance of Cylindrical Solenoids." By A. G. Webster.

Contributions from the Gray Herbarium of Harvard University. New Series. — No. XXXIV. I. "New Species of Senecis and Schoenocaulon from Mexico." By J. M. Greenman. II. "New or otherwise noteworthy Spermatophytes, chiefly from Mexico." By B. L. Robinson. III. "New Plants from Guatamala collected by C. C. Deam." By B. L. Robinson and H. H. Bartlett. IV. "Diagnoses of New Spermatophytes from Mexico." By M. L. Fernald. Presented by B. L. Robinson.

Nine hundred and seventy-second Meeting.

MARCH 13, 1907. — STATED MEETING.

The Academy met at its House.

The PRESIDENT in the chair.

There were present twenty-one Fellows.

Letters were read from Henry S. Pritchett, Henry G. Denny, David W. Cheever, and Jeremiah Smith, resigning Fellowship; from the Michigan Agricultural College, inviting the Academy to be represented by delegates at its fiftieth anniversary, May

28–31, 1907; from the Smithsonian Institution, informing the Academy of the election of Charles Doolittle Walcott as its Secretary; from G. Capellini, inviting the Academy to participate in the celebration of the three hundredth anniversary of the death of Ulisse Aldrovandi, June 12, 1907, at Bologna; also, printed communications regarding the adoption of an international language.

On motion of the Recording Secretary, it was unanimously

Voted, To invite Dr. William Everett, Professor Amos E. Dolbear, and Mr. Henry G. Denny to attend the meetings of the Academy, and to make use of the library.

The Chair announced the following death: —

Dimitri Mendeleeff, Foreign Honorary Member in Class I, Section 3.

The following gentlemen were elected Members of the Academy: —

William Zebina Ripley, of Newton, as Resident Fellow in Class III, Section 3 (Political Economy and History).

Edward Henry Hall, of Cambridge, as Resident Fellow in Class III, Section 4 (Literature and the Fine Arts).

William Coolidge Lane, of Cambridge, as Resident Fellow in Class III, Section 4 (Literature and the Fine Arts).

Magnus Gustav Retzius, of Stockholm, as Foreign Honorary Member in Class II, Section 3 (Zoölogy and Physiology), in place of the late Albert von Kölliker.

Hermann Diels, of Berlin, as Foreign Honorary Member in Class III, Section 2 (Philology and Archaeology), in place of the late J. W. A. Kirchhoff.

The President appointed the following Councillors to act as Nominating Committee: —

William T. Sedgwick, of Class II.
Elihu Thomson, of Class I.
Andrew McF. Davis, of Class III.

The following Communications were given: —

Professor S. P. Sharples, "Cobalt and Silver Deposits of Cobalt, Canada."

Professor D. W. Johnson, "The Volcanic Necks of the Mt. Taylor Region, New Mexico" (by invitation).

The following papers were read by title: —

"The Process of building up the Voltage and Current in a Long Alternating-Current Circuit." By A. E. Kennelly.

"High Electromotive Force with its Application to Spectrum Analysis." By John Trowbridge.

Nine hundred and seventy-third Meeting.

APRIL 10, 1907.

The PRESIDENT in the chair.

There were present sixteen Fellows.

The Corresponding Secretary read the following letters: From Edward H. Hall, William C. Lane, and William Z. Ripley, acknowledging election as Resident Fellows; from Hermann Diels, acknowledging election as Foreign Honorary Member; from Amos E. Dolbear and Henry G. Denny, thanking the Academy for its invitation to attend the meetings and to use the library; from the Geological Society of London inviting the Academy to appoint a delegate to attend its centennial celebration, September 26, 27, and 28, 1907; from the Comité Géologique de la Russie, announcing the death of M. Nicholas Sokolow; from Columbia University in the City of New York, announcing the Loubat prizes to be awarded in 1908.

The Chair announced the following death: —

Marcellin Berthelot, Foreign Honorary Member in Class I, Section 3.

The following delegates were appointed by the chair: —

Professor Ephraim Emerton (Professor Angelo Celli of Rome, alternate), to attend the celebration at Bologna of the three hundredth anniversary of the death of Ulisse Aldrovandi, June 12, 1907; President James Burrill Angell, to attend the celebration at Lansing, Michigan, of the fiftieth anniversary of the Michigan Agricultural College, May 28 to 31, 1907; Professor Edward Laurens Mark, to attend the Seventh International Zoölogical Congress at Boston, August 19 to 23, 1907.

The following communications were given: —

"On the Physiological Basis of Illumination." By Dr. Louis Bell.

"Meteorological Observations in 1906 above the Tropical and Equatorial Atlantic." By Professor A. Lawrence Rotch.

The following paper was presented by title: —

"The Demagnetizing Factors for Cylindrical Magnets of Different Dimensions." By C. L. B. Shuddemagen. Presented by B. O. Peirce.

Nine hundred and seventy-fourth Meeting.

MAY 8, 1907. — ANNUAL MEETING.

The PRESIDENT in the chair.

There were present twenty-two Fellows.

Letters were read from E. F. Sawyer and J. S. Kingsley, resigning Fellowship; from Gustav Retzius, acknowledging election as Foreign Honorary Member; from the New York Academy of Sciences, inviting the Academy to be represented at the celebration of the two hundredth anniversary of the birth of Carl von Linné, and also to contribute an official document appreciative of the work of Linné.

On motion of the Recording Secretary it was

Voted, That the appointment of Delegates to the celebrations of the Geological Society of London and the New York Academy of Sciences be intrusted to the President.

The Chair announced the death of Sir Michael Foster, Foreign Honorary Member in Class II, Section 3.

The annual report of the Council was read.[1]

The annual report of the Treasurer was read, of which the following is an abstract: —

GENERAL FUND.

Receipts.		
Investments	$1,683.01	
Assessments	1,880.00	
Admission fees	40.00	
Rent of offices	1,200.00	$4,803.01
Expenditures.		
General expenses	$3,603.47	
Library	1,199.54	$4,803.01

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[1] See p. 761.

Rumford Fund.

Receipts.

Balance, April 30, 1906	$ 451.23	
Investments, etc.	2,614.75	$3,065.98

Expenditures.

Research	$1,490.00	
Publication	788.54	
Library	149.35	
Charged to reduce book value of stocks	451.23	$2,879.12
Balance, April 30, 1907		186.86
		$3,605.98

C. M. Warren Fund.

Receipts.

Balance, April 30, 1906	$ 940.06	
Investments	347.74	$1,287.80

Expenditures.

Research	$ 450.00	
Vault rent	4.00	
Premium on bonds charged off	50.00	
Accrued interest on bonds bought	20.83	$ 524.83
Balance, April 30, 1907		762.97
		$1,287.80

Publication Fund.

Receipts.

Balance, April 30, 1906	$ 961.68	
Investments	2,854.50	
Sale of publications	130.35	
Authors	179.23	$4,125.76

Expenditures.

Publication	$3,275.42	
Charged to reduce book value of investments	625.00	
Vault rent	12.50	$3,912.92
Balance, April 30, 1907		212.84
		$4,125.76

The following reports were also presented : —

Report of the Librarian.

During the past year the Assistant Librarian and Miss Wyman, as cataloguer, have been employed in verifying and continuing the type-written catalogue, begun by Dr. Holden, and also in classifying the books according to the classification adapted by him to this library. The subjects, mathematics, astronomy, physics, light, heat, electricity, chemistry, the useful arts (including engineering), natural history, geology, mineralogy, and about one-half of meteorology, are entirely catalogued and classified. This includes all serial publications relating to the subjects mentioned. There remains to be done, paleontology, botany, zoölogy, agriculture, medicine, the moral and political sciences, and the books and serial publications on general science. As Miss Wyman can only give two or three hours a day during the coming year, the catalogue will probably not be completed for some months, but the thoroughness with which the work has been done compensates for the length of time taken.

It is very much to be desired that each member of the Academy should present to the library a copy of any scientific work of which he is the author. The books on the various subjects were, as a rule, well chosen in the past, and form what might be called the nucleus to a valuable library, but some years ago, through lack of funds, it was decided to purchase no more books from the General Fund; therefore donations are much needed.

The accessions during the year have been as follows : —

	Vols.	Parts of Vols.	Pams.	Maps.	Total.
By gift and exchange . . .	144	2396	85	8	2633
By purchase — General Fund	3	690			693
By purchase — Rumford Fund	1	336			337
Total	148	3422	85	8	3663

61 books have been borrowed from the library by 18 persons, including 10 Fellows. The library has been consulted many times when no books were taken.

All the books borrowed during the year have been returned for the annual examination. Of the books reported as still out a year ago, all have been returned except 5 (taken out by one person).

The expenses charged to the library are as follows : Miscellaneous, $400 (which includes $206.25 for cataloguing) ; Binding, $417.65, General, and $44.70, Rumford, Funds ; Subscriptions, $381.89, General, and $104.65, Rumford, Funds; making a total of $799.54 for the General, and $149.35 for the Rumford, Funds as the cost of binding and subscriptions.

A. Lawrence Rotch, *Librarian.*

May 8, 1907.

Report of the Rumford Committee.

During the past year the Committee has made the following grants in aid of research, from the amount placed at its disposal by the Academy for that purpose.

Oct. 10, 1906. Professor Arthur A. Noyes, of the Massachusetts Institute of Technology, for the construction of a calorimeter for the determination of heats of reaction at high temperatures . . .	$300
Professor R. W. Wood, of the Johns Hopkins University, for the purchase of quartz lamps (additional appropriation) .	200
Nov. 14, 1906. Professor Norton A. Kent, of Boston University, for the continuation of work on spectral lines (additional appropriation)	75
Professor L. R. Ingersoll, of the University of Wisconsin, for an investigation of the Kerr Effect in the infra red rays . . .	200
Professor Frederick E. Kester, of the Ohio State University, for a research on the thermal properties of gases flowing through porous plugs (additional appropriation)	315
March 13, 1907. Dr. Harry W. Morse, of Harvard University, for his research on fluorescence (additional appropriation) .	400

Since the last Annual Meeting papers as follows have been published at the expense of the Rumford Fund. Two additional papers are now in press.

"Dispersion in Electric Double Refraction." H. L. Blackwell, May, 1906.

"The Thermal Conductivity of Lead." F. L. Bishop, May, 1906.

"Fluorescence and Magnetic Rotation Spectra of Sodium Vapor, and their Analysis." R. W. Wood, November, 1906.

"Expansion and Compressibility of Ether and of Alcohol in the Neighborhood of their Boiling Points." A. W. Smith, January, 1907.

"Concerning the Adiabatic Determination of the Heats of Combustion of Organic Substances, especially Sugar and Benzol." T. W. Richards and Messrs. Henderson and Frevert. March, 1907.

"On the Thomson Effect and the Temperature Coefficient of Thermal Conductivity in Soft Iron between 115° and 204° C." E. H. Hall and Messrs. Campbell, Serviss, and Churchill. March, 1907.

"Concerning Position Isomerism and Heats of Combustion." L. J. Henderson. March, 1907.

"Temperature of Mars. A Determination of the Solar Heat Received." P. Lowell. March, 1907.

"The Transmission of Röntgen Rays through Metallic Sheets." J. M. Adams. April, 1907.

Reports of progress in their respective researches have been received from Messrs. A. L. Clark, J. A. Dunne, E. B. Frost, G. E. Hale, W. I. Humphreys, L. R. Ingersoll, N. A. Kent, F. E. Kester, A. B. Lamb, C. E. Mendenhall, R. S. Minor, H. W. Morse, A. A. Noyes, J. A. Parkhurst, T. W. Richards, F. A. Saunders, C. B. Thwing, J. Trowbridge, R. W. Wood.

At its meeting of January 9, 1907, the Committee voted for the first time, and at its meeting of February 13, 1907, for the second time, to recommend to the Academy that the Rumford Premium be awarded to Edward Goodrich Acheson for the Application of Heat in the Electric Furnace to the Industrial Production of Carborundum, Graphite, and other New and Useful Substances.

Charles R. Cross, *Chairman.*

May 8, 1907.

Professor Cross continued as follows: —

Mr. President and Gentlemen of the Academy, — In presenting the claims of Mr. Acheson for the Rumford Premium, in view of the character of the work upon which the recommendation of the Committee is based, instead of making an independent statement of my own, I will read a report upon that work which was presented to the Committee by one of its members, than whom there is none more competent to pronounce an opinion upon any subject concerning applied electricity. I hardly need to say that I refer to Professor Elihu Thomson.

The report is as follows:

"The early experimenters with the carbon arc from voltaic batteries found that the temperature developed transcended that of all other sources of artificial heat, and numerous substances subjected thereto were found to undergo profound changes. It may suffice to quote from Silliman's Physics, a text-book in common use some forty years ago, page 589, paragraph 886 of the edition of 1870, 'Heat of the Voltaic Arch Deflagration': 'Where the positive electrode is fashioned into a small crucible of carbon, gold, silver, platinum, mercury, and other substances are speedily fused, deflagrated, or volatilized, with various colored lights. The fusion of platinum (like wax in a candle) before the voltaic arch is significant of its intense heat, and still more, the volatilization and fusion of carbon, a result first announced by Professor Silliman in 1822 and since confirmed by Despretz, who by the union of the heat of six hundred carbon couples arranged in numerous parallel series, and conjoined with the jet of an oxyhydrogen blowpipe, and the heat of the midday sun, focalized by a powerful burning glass, succeeded in volatilizing the diamond, fusing magnesia and silica, and softening anthracite. The diamond is also softened, and converted into a black spongy mass resembling coke, or, more nearly, the black diamond found in the Brazilian mines.'

"The fusion of carbon referred to is evidently a mistake, but the softening of anthracite probably resulted in its conversion into graphite.

"Upon the advent of the dynamo during the decade of 1870 to 1880, the ability to obtain and maintain electric arcs with comparative ease made it possible to apply electric heat to larger crucibles and to note again the facile conversion of impure varieties of carbon into graphite. The first attempts to apply electric heating on a fairly large scale in obtaining new products was probably made by Cowles in 1886, using a mixture of carbon, aluminum oxide, and copper, whereby there was formed aluminum bronze. The operation involved the direct reduction of alumina by carbon, but if this were attempted without the presence of the alloying metal copper, a carbide of aluminum was formed and no metal. The operation was rather irregular and uncertain, but stands as a worthy effort to apply electricity to smelting. The heat generated in the mass of materials undergoing the operation was due to resistance of innumerable contacts throughout the granular mass, to the resistance of the materials themselves, and possibly to incipient arcing between particles.

"Mr. Edward G. Acheson, who had assisted in the Edison Menlo Park laboratory in 1880 and 1881, and who up to 1889 and later was connected with electric work as engineer, superintendent, or electrician, began to work with an electric furnace in 1891. In attempting to 'impregnate clay with carbon under the influence of the high heat obtainable with the electric current' he noted the formation of a few bright specks. After having separated out one of these specks, he drew it across a pane of glass, which it scratched and cut. This led to further experiments, and a small vial of the new product was taken to New York under the name 'carborundum,' as Mr. Acheson was laboring under the mistake that it contained carbon and corundum. It was tried in cutting diamond, with the result that the diamond cutter bought the material at thirty cents per carat. This was the first sale of the new abrasive. On finding that it was the silica in the clay which had reacted with the carbon, sand was substituted for the clay before used. Mr. Acheson then planned a furnace substantially the same as that now used in the manufacture at Niagara, — a central core of carbon pieces resting on the floor of the furnace and connecting heavy carbon terminals or electrodes, around which core was packed the mixed materials to be heated, which in the case of the production of carborundum are sand, coke-powder, and a little common salt.

"Meeting with troubles and trials, the usual lot of pioneers, and having his efforts at last crowned with success, the carborundum manufacture has become a large industry. In 1894 a steam generating plant of less than 150 horse power was used, and the cost of production greatly restricted the applications of the product. Only one half the product found a market. It was then that, in spite of the opposition of the directors of his company, Mr. Acheson insisted on removing to Niagara, so as to manufacture more cheaply with large amounts of relatively cheap electric energy. The wisdom of this insistence soon became manifest. One thousand horse power was consumed in a single carborundum furnace. In 1904 the Carborundum Company had a plant of five thousand electrical horse power, and produced over seven millions of pounds of carborundum or silicon carbide.

"Later on Mr. Acheson found that when carborundum was very highly heated in the furnace in which it was formed the silicon was evaporated from the crystals and graphite left as a pseudomorph. This observation led the way to experiments and methods which formed the basis of another large industry carried on by the National Acheson Graphite Company at Niagara. Its product is plumbago, a graphite made by heating to a high temperature impure carbon, such as anthracite coal. The silica and clay in the ash apparently provide material for the chemical changes which result in the conversion, and the impurities are themselves finally vaporized out of the mass to a large extent. That impure carbon was convertible into graphite at high temperatures was known. Rods of carbon were so converted by the writer in 1882. The carbon electrodes of arc lights, especially large arcs, were noted to have been after burning so converted for a small distance from the ends at the arc, and this was particularly noticeable at the positive craters of large arcs, which, of course, during burning attained a temperature limited only by the sublimation of the carbon itself. It is, however, due to Mr. Acheson that the production of artificial graphite has become a great commercial success. Rods, bars, plates of carbon converted into Acheson graphite, are now extensively used in electro-chemical and electro-metallurgical industries, almost to the complete exclusion of the ordinary moulded carbon formerly used.

The graphite is used as a filler for dry batteries, and is being applied in place of natural graphite in stove polish, lubrication, foundry facings, and as a pigment for paints. It is easily reducible to a very fine powder. The graphite is nearly pure, containing about one-half per cent of impurities when used for electro-chemical electrodes, and about three per cent when used for paint. A good quality of natural graphite may be eighty-five per cent pure, and much of it on the market is as low as forty-five per cent. The solid bars of artificial graphite have a relatively high electric conductivity, estimated at about four times that of ordinary amorphous carbon rods. They disintegrate in electro-chemical work at a much lower rate than the former electrodes, for which they have become the substitute. In some cases the life of the electrode is increased twelve times. During 1905 the Acheson Graphite Company produced about two and a half millions of pounds of graphite electrodes and nearly two millions of pounds of bulk graphite, made principally from anthracite coal.

"Two other electric furnace products have been added more recently as the outcome of Mr. Acheson's experiments. In attempting to reduce the element silicon by electrically heating an intimate mixture of fine graphite and pure silica, the amount of carbon being only that sufficient to remove the oxygen, Mr. Acheson noted not only the reduction of the silicon in part, but the production of a quantity of a greenish gray fluffy substance which, from the circumstances of its production, he recognized as highly refractory. The manufacture of silicon itself was turned over to the carborundum company in 1901, since which time this manufacture has been extended and perfected so that the element silicon, once a rare curiosity of the chemical laboratory, seen only in small crystals and in samples of small amount, has become a commercial product of low price.

"The greenish gray fluffy mass referred to when analyzed gave the formula Si_2C_2O, and was named siloxicon. It is amorphous and said to be inert to acid and basic slag, insoluble in fused iron, and packs or binds itself when pressed and then heated to about 2500 degrees F. Briquettes can thus be made, resisting the highest furnace temperatures. Attention is now being given to this substance as a material for crucibles, muffles, fire bricks, fire-resisting linings, etc.

"Mr. Acheson has contributed several papers to technical journals and societies, an incomplete list being as follows: —

"'The Influence of the Condenser on Disruptive Discharges.' Electrical World, July 7, 1888.

"'Disruptive Discharges and their Relations to Underground Cables.' Before the National Electric Light Association, August 29, 1888.

"'Lightning Arresters and the Photographic Study of Self-Induction.' Before the American Institute of Electrical Engineers, January 8, 1889.

"'Carborundum: its History, Manufacture, and Uses.' Before the Franklin Institute, June 21, 1893.

"'Graphite: its Foundation and Manufacture.' Before the Franklin Institute, March 15, 1899.

"'Egyptianized Clay.' Before the American Ceramic Society, in 1903.

"'Discovery and Invention.' Before the Society of Mining Engineers, Massachusetts Institute of Technology, March 9, 1906.

"He has received some forty United States patents, chiefly relating to carborundum, graphite, and other products of the electric furnace.

"In conclusion, it may be said that the labors of Mr. Acheson have, through the agency of electric heat, in furnaces especially designed for its utilization, and by methods devised by him, provided a new abrasive only inferior to the diamond in hardness and toughness, much harder than emery or carborundum, of which it largely takes the place, whether used in the form of graded sizes of grains or in slabs, or in the construction of grinding wheels. His work has also developed a source of nearly pure graphite aside from the usual mining of this substance, and which promises to become the principal supply of such material. It has supplied compact graphite in any form desired, and of high endurance and purity, for electrodes in electro-chemical industry. There has resulted from the work of Mr. Acheson a commercial production of the element silicon, before known in small amounts as a curiosity of the chemical cabinet. This element promises to fill a need for electric-resistance materials, and for chemical ware unattackable by strong acids even when hot, hydrofluoric among the number. It can be cast in any form in ordinary moulds, and stands rapid changes of temperature when in the form of crucibles or dishes not too thick. It oxidizes but slightly in the air even at high temperatures. Lastly, the work of Mr. Acheson provides a new material, — siloxicon, — the properties of which promise to render it a very valuable addition to our resources in high temperature furnace processes. He is to be commended for his persistency, ingenuity, and sagacity in applying the heating effect of electrical energy to technical problems of the highest importance."

I can add to this only that the committee is heartily unanimous in the opinion that the labors of Mr. Acheson fully entitle him to the honor of the award.

It was then

Voted, That the Rumford Premium be awarded to Mr. Edward Goodrich Acheson for the "Application of Heat in the Electric Furnace to the Industrial Production of Carborundum, Graphite, and other new and useful Substances."

Report of the C. M. Warren Committee.

The C. M. Warren Committee beg leave to report that during the last year they have made the following grants from the C. M. Warren Fund: —

Professor Walter L. Jennings, of the Worcester Polytechnic Institute for a research on the acetyl derivatives of rosaniline and pararosaniline	$100
Dr. J. Bishop Tingle, of Johns Hopkins University, for research on the hydrazine derivatives of the camphor oxalic acids	50
Mr. Richard C. Tolman, Research Laboratory of Physical Chemistry, Massachusetts Institute of Technology, for the construction of apparatus to be used in the measurement of the difference in electrical potential between the inner and outer ends of rotating tubes containing salt solutions, this apparatus to be the property of the American Academy of Arts and Sciences, and to be returned to the C. M. Warren Committee on the completion of Mr. Tolman's investigations	300

Acknowledgments of these grants and satisfactory reports of progress have been received.

Leonard P. Kinnicutt, *Chairman*.

May 8, 1907.

Report of the Publication Committee.

During the last year there were published of the Proceedings three numbers of Volume XLI (33–35), and twenty-six numbers of Volume XLII; also one biographical notice; in all, 854 + v pages and eleven plates. Seven numbers of Volume XLII (13, 17, 21, 22, 24, 25, and 26) were paid for from the income of the Rumford Fund.

Of the Memoirs, one number (Volume XIII, No. 4, pp. 149–179, plates IX–XXIV) has been published.

Under the ruling that balances of appropriations unexpended at the end of the year revert to the general funds of the Academy, and that the proceeds from sales of publications are not available for the purposes of publication except by special vote of the Academy to that effect, the funds available for publication during the year just closed have been limited to the appropriation of $2600 voted at the annual meeting, May 9, 1906, and an additional appropriation of $500 voted January 9, 1907; in all, $3100. However, several authors bore a portion of the expense of their papers. Sometimes it was convenient to have the author pay a lump sum to the Academy rather than send him a separate bill. The money so received aggregated $179.23, and was turned over to the Treasurer for credit to the General Publication Fund. Against this total sum of $3279.23 bills aggregating $3279.22 have been approved, thus leaving an unexpended balance of one cent.

There are now three papers in press for the Proceedings, the estimated unpaid expense of which is $282, and unpaid bills amounting to $27.25.

Bills for publications on account of the Rumford Fund amounting to $887.01 have been forwarded to the chairman of the Rumford Committee for approval.

One number of the Memoirs, estimated to cost for the text $145, and one number of the Proceedings, estimated to cost $86, are in press as Rumford papers.

EDWARD L. MARK, *Chairman.*

May 8, 1907.

FINANCIAL REPORT OF THE COUNCIL.

The income of the Academy for the year 1907–8, as estimated by the Treasurer, is as follows:

GENERAL FUND	Investments	$1608	
	Assessments	1800	
	Rent of offices	1200	$4608
PUBLICATION FUND	Appleton Fund investments	$ 556	
	Centennial Fund investments	2178	$2734
RUMFORD FUND	Investments		$2547
WARREN FUND	Investments		$584

The following appropriations are recommended:

GENERAL FUND.

House expenses	$1200	
Library expenses	1600	
Books, periodicals, and binding	900	
Expenses of meetings	250	
Treasurer's office	150	$4100

Rumford Fund.

Research	$1000	
Periodicals and binding	150	
Books and binding	50	
Publication	700	
To be used at discretion of Committee	264	
Unexpended balance of 1906–7 appropriation	186	$2350

C. M. Warren Fund.

Research	$500

Publication Fund.

Publication	$2400

In accordance with the recommendations in the foregoing report it was

Voted, To appropriate for the purposes named the following sums: —

From the income of the General Fund	$4100
From the income of the Rumford Fund	2350
From the income of the C. M. Warren Fund	500
From the income of the Publication Fund	2400

On the motion of the Treasurer, it was

Voted, That the annual assessment for the ensuing year be ten dollars ($10).

The annual election resulted in the choice of the following officers and committees: —

WILLIAM W. GOODWIN, *President.*
JOHN TROWBRIDGE, *Vice-President for Class I.*
HENRY P. WALCOTT, *Vice-President for Class II.*
JOHN C. GRAY, *Vice-President for Class III.*
EDWIN H. HALL, *Corresponding Secretary.*
WILLIAM WATSON, *Recording Secretary.*
CHARLES P. BOWDITCH, *Treasurer.*
A. LAWRENCE ROTCH, *Librarian.*

Councillors for Three Years.

Henry P. Talbot, of Class I.
John E. Wolff, of Class II.
George L. Kittredge, of Class III.

Finance Committee.

William W. Goodwin,
Eliot C. Clarke,
Francis Bartlett.

Rumford Committee.

Charles R. Cross, Arthur G. Webster,
Edward C. Pickering, Elihu Thomson,
Theodore W. Richards, Erasmus D. Leavitt,
Louis Bell.

C. M. Warren Committee.

Leonard P. Kinnicutt, Charles R. Sanger,
Robert H. Richards, Arthur A. Noyes,
Theodore W. Richards, Henry P. Talbot,
George D. Moore.

The following standing committees were appointed by the Chair: —

Publication Committee.

Wallace C. Sabine, of Class I, Edward L. Mark, of Class II,
Crawford H. Toy, of Class III.

Library Committee.

Harry M. Goodwin, of Class I, Samuel Henshaw, of Class II,
Henry W. Haynes, of Class III.

Auditing Committee.

A. Lawrence Lowell, Frederick J. Stimson.

House Committee.

William R. Ware, A. Lawrence Rotch,
Morris H. Morgan.

The following gentlemen were elected members of the Academy: —

Charles Ladd Norton, of Boston, to be a Resident Fellow in Class I, Section 2 (Physics).

George Washington Pierce, of Cambridge, to be a Resident Fellow in Class I, Section 2 (Physics).

Gregory Paul Baxter, of Cambridge, to be a Resident Fellow in Class I, Section 3 (Chemistry).

The following communications were given:

"Variable Stars in the Globular Clusters." By Professor S. I. Bailey.

"The Eastern Escarpment of the Mexican Plateau." By Professor W. M. Davis.

The following paper was presented by title:

Contribution from the Research Laboratory of Physical Chemistry. — No. 15. "On the Density, Conductivity, and Viscosity of Fused Electrolytes." By H. M. Goodwin and R. D. Mailey.